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ABSTRACT

This bulletin is one in a series of environmental education activity guides for grades K-12, developed and field-tested by teachers in the Montgomery County (Maryland) Public Schools. Primarily for use in the middle grades four through six, the guides are not intended to constitute complete units in themselves. They are, rather, a compilation of activities considered appropriate for particular environmental studies. In this guide about ponds, for grades five and six, activities are entitled: Identifying Animal Life, Identifying Plant Life, Using a Plankton Tow, Measuring pH, Measuring Pond Depth, Measuring Pond Temperatures, Observing Suspended Particles, Measuring Turbidity, Bottom Sampling, Observing Currents, and Measuring the Inflow and Outflow of a Pond. Each activity includes the instructional objective, procedures to follow, and materials required. Teacher notes are added when necessary. A student evaluation sheet concludes the bulletin. Related documents in the series are SE 015 885 through SE 015 887 and SE 015 889 through SE 015 893. (BL)

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Activities for Studying

Ponds

Environmental Education Series · Bulletin No. 247-D

MONTGOMERY COUNTY PUBLIC SCHOOLS ROCKVILLE MARYLAND Homer O Elsenood Superintendent of Schools

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ENVIRONMENTAL EDUCATION
ACTIVITIES FOR STUDYING PONDS
(Limnology)
GRADE LEVEL 5 – 6

Bulletin No. 247-D

Montgomery County Public Schools
Rockville, Maryland
Homer O. Elseroad
Superintendent of Schools

INTRODUCTION

For some time, there has been a need for curriculum materials to assist teachers who wish to move the teaching/learning experience beyond the school walls. Although individual schools have prepared materials useful to their own unique purposes, such information and teaching aids have not generally been shared with other schools.

This series of bulletins on Environmental Education was developed after arrangements were made in Area 11 for approximately a dozen 12-month teachers to produce outdoor education materials during the summer of 1969. Field testing of these materials occurred, primarily in Area 11, during the 1969-70 school year.

In the summer of 1970, an Outdoor Education Curriculum Development Workshop was conducted at Randolph Junior High School, during which twelve teachers developed additional materials and reviewed and tested those prepared earlier.

The bulletins in this Environmental Education series are not intended to constitute complete units in themselves. They are, rather, a compilation of activities considered appropriate for particular environmental studies. Whether the series should be used separately or as a supplement to other aids should be determined by the needs and purposes of each teacher and his students.

A word of explanation about format: Each activity suggested has its own stated instructional objective. The achievement of that objective will be an individual experience for each student, even though in some cases the procedures suggested may be group- rather than individually-directed.

PURPOSE

The activities in this unit constitute a study of the pond. Emphasis is on both life in the pond and its chemical and physical characteristics. A number of the activities are suitable also for investigating a stream and could be used to compare a pond and stream.

Limnology is the "science dealing with biological and other phenomena pertaining to inland waters; the study of standing waters (Greek *limne*, marshy lake; *logos*, discourse.)"

There is an increasingly keen interest in oceanography today. It is believed that pond study will awaken and further such an interest among students. Inasmuch as activities for an oceanography unit are often difficult to arrange, these activities have been written so that teachers can build oceanography concepts with an activity unit. These activities emphasize the process and method of investigation. As often as possible, each student will observe, measure, classify, predict, and record data for himself. Although elementary teachers and students may not be familiar with metric measurement, the metric system is mentioned throughout this set of activities. It is hoped this system will receive as much attention as the English system.

Limnology builds on and adds to units previously taught about living things and the earth's changing surface. The concepts in these activities will recur throughout the student's course work in the biological and physical sciences.

The activities may be taught separately or in their entirety depending on the wishes of the classroom teacher and the facilities and materials available to him. They may be taught as one unit of approximately 10-15 class sessions or spread through the year – in the fall, in the winter, and again in the spring. By repeating them at intervals, students will be able to observe seasonal changes of temperature and pond activity.

The construction of a grid-sketch of the pond or lake being studied will give the class a frame of reference as activities are conducted or recorded. The student can use the grid-sketch to pinpoint where he collected his specimen or made his observation. Readings should be made by the student as he studies each area.

TABLE OF CONTENTS

Introduction iii

Purpose iv

Activities:

1. Identifying Animal Life 1
2. Identifying Plant Life 2
3. Using a Plankton Tow 3
4. Measuring pH 5
5. Measuring Pond Depth 6
6. Measuring Pond Temperatures 7
7. Observing Suspended Particles 8
8. Measuring Turbidity 9
9. Bottom Sampling 10
10. Observing Currents 11
11. Measuring the Inflow and Outflow of a Pond 12

Basic References 13

Student Evaluation Sheet 15

Activity 1: Identifying Animal Life

Instructional Objective:

The student will identify and order the collection of samples from the pond.

Procedures:

The student will –

1. Collect samples of pond water to be observed with a hand lens, microscope, and microprojector. Samples can be collected from various locations of the pond either in plastic bags or small plastic or glass bottles and taken to the place of viewing. In some cases, the teacher may prefer taking the microscope to the pond where the student can collect this specimen and observe it by the side of the pond.

2. Group the animals according to the way they move, such as flowing slowly like an amoeba or moving rapidly like a paramecium.

3. Classify and record the different kinds of animal life seen in the pond by looking in the water from the shoreline.

Materials:

plastic containers or jars
microscope slides
cover slips
medicine droppers
hand lens
microscope
microprojector

Note:

The teacher may find it helpful to review the "Comments for Teaching" in the MCPS science unit entitled *Cells* for ideas on observing both microscopic plant and animal life.

Some animals seen in the pond may not be easily identified. Interested students may be directed to books which identify pond life, but it would not be necessary nor important to identify animals. Descriptions, using observed characteristics, could be emphasized and drawings or sketches could be made. Students may be interested in making up names for these unknown animals based on the characteristics observed.

Activity 2: Identifying Plant Life

Instructional Objective:

The student will identify and order the collection of life from the pond.

Procedures:

The student will –

1. Collect samples of plant life from the pond and observe them with a hand lens, microscope, or microprojector (for small group activity).

2. Identify and group plants according to their similarity and difference in cellular structure.

3. Classify and record the different kinds of plants seen in the pond by looking in the water from the shoreline.

4. Compare and contrast plants along the edge; e.g., floating plants and submerged plants.

Materials:

plastic containers or jars
slides
coverslips
medicine droppers
hand lens
microscope
microprojector

Activity 3: Using a Plankton Tow

Instructional Objective:

The student will demonstrate the use of a plankton tow net and observe that the action of the net concentrates the quantity and variety of organisms and suspended particles collected as compared with a sample dipped from the water.

Procedures:

The student will –

1. Collect tow samples from different locations around the pond and compare the contents. (See "Note" for directions.)

2. Collect tow samples from different depths (such as surface, 1/2 meter, 1 meter, etc.) and compare the contents.

3. Observe the collected material with a hand lens or microscope, and compare it with a sample that is hand-dipped from the pond.

Materials:

commercial plankton tow net (or an improvised one) with tow line
plastic or glass containers
medicine droppers
slides
coverslips
methyl cellulose
hand lens
microscope
microprojector

Note:

A commercial tow net is made from silk bolting (No. 12 silk is equivalent to about 125 meshes, or openings, to one inch). A sample net can be improvised by sewing a woman's nylon stocking to a six-inch diameter ring made from coat hanger wire. The foot end of the stocking is removed and a small plastic or glass vial (such as a pill container) is firmly attached. A small swivel, available where fishing equipment is sold, costs about ten cents. A nylon cord is attached as a tow line. After each use, the net should be rinsed and air dried before it is stored.

A. nylon cord, 30 feet long

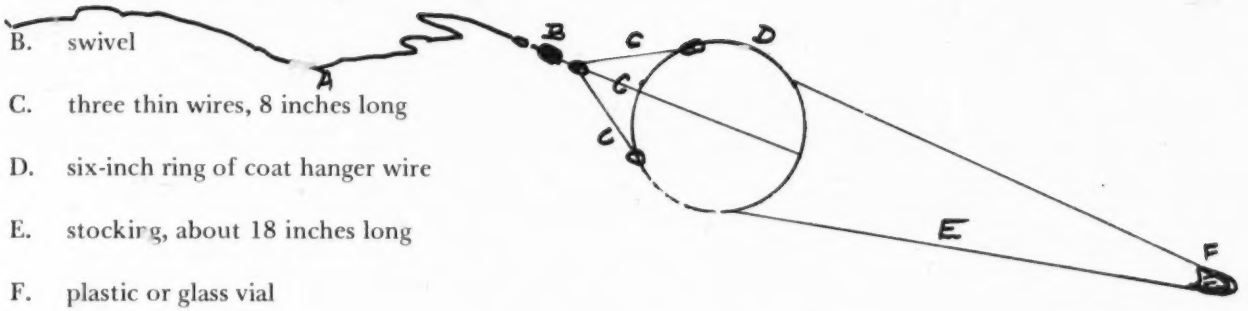
B. swivel

C. three thin wires, 8 inches long

D. six-inch ring of coat hanger wire

E. stocking, about 18 inches long

F. plastic or glass vial



A plankton tow net is efficient because, as it is pulled across the pond, water passes out through the net while particles in the water accumulate in the container at the end of the net. To collect the sample, toss the net out about twenty feet from the shore. Caution students to place one foot on the end of the tow line, or tie it to some heavy object. Allow the net to sink just below the surface, or lower, and steadily pull it towards the shore, being very careful not to snag the net on submerged objects. This can be repeated, without emptying the container, to further concentrate the sample. The sample is then poured into a collection jar for further investigation.

Methyl cellulose is a commercially prepared, thickened liquid which is used to help observe fast-moving microscopic organisms. Use a toothpick to smear a tiny drop of methyl cellulose onto the center of a glass slide. Then use a medicine dropper to add a drop of the sample to be observed. Add a cover slip. The tiny organisms, which usually swim out of view very quickly, are now trapped among the fibrous material in the methyl cellulose. These fibers are transparent and do not interfere with viewing.

Activity 4: Measuring pH

Instructional Objective:

The student will demonstrate whether the pond water is acid or alkaline by using a pH indicator, vial of pond water, and a pH scale or chart.

Procedures:

The student will –

1. Test the pH of the pond water. (See "Note" for directions.)

2. Compare the pH of the pond with the water flowing into or out of the pond.

3. Compare the pH of the pond with the pH of the soil surrounding the pond.

Materials:

pH indicators: litmus paper, bromthymol blue, or others

Note:

The pH number is a shorthand way of indicating the hydrogen ion concentration in the water. The larger the pH number, the more alkaline (basic) the water; the smaller the number, the more acid the water. An arbitrary scale ranges from 1.0 to 14.0, with 7.0 being neutral, like distilled water. As examples, lemon juice and soft drinks are acidic; and ammonia and bleach are alkaline.

The teacher should point out that the pH of the water has an effect on the life in the pond. If the pH range is between 6.5 and 8.3 there is no danger to the fish. When the range is between 4.0 and 6.5 or 8.3 and 9.0, the water may support fish; but they will not grow to their expected maturity, and there will be a decline in reproduction. When the range is below 4.0 and above 9.0, the water is toxic to fish; but some aquatic organisms live in these conditions.

Each student can use a piece of red and a piece of blue litmus paper to dip into the pond. If the blue piece of litmus paper turns red, the water is acid. If the red should turn blue, the water is alkaline. Wet fingers may affect the readings. If neither paper changes its color, then one would suspect that the water is neither acid enough to change the blue litmus paper or alkaline enough to turn the red litmus paper. However, this may be due to the limited range of litmus. Other indicators may be more sensitive.

One can make a more accurate test by using an aquarium pH test kit (which can be purchased from any store carrying aquarium supplies). Take a sampling of water and add the directed drops of indicator liquids, allowing it to mix with the pond water. With a pH chart or color scale, it is possible to determine how acid or alkaline the water is by comparing the coloration of the water with the color chart. (The color chart is usually included with the kit, when purchased.)

Activity 5: Measuring Pond Depth

Instructional Objective:

The student will describe the various depths of the pond and will construct a graph or table of various depths.

Procedures:

The student will –

1. Measure the depth of the pond with a weighted, marked string.

2. Record measurements on a graph, chart, or grid of the pond.

Materials:

ruler or tape measure
string, marked in metric or English units
weight
pole

Notes:

To measure the depth of the pond at various distances from the shore may very well create a problem. The depth can be measured around a pier; but to measure any distance from the shore, a pole (with the string and weight attached at the end) will be needed. In measuring the depth, the string must be held perpendicular to the bottom. (Caution: A boat should be used only if life-saving equipment and a trained operator are present.)

Activity 6: Measuring Pond Temperature

Instructional Objective:

The student will describe various locations by measuring temperature at different depths.

Procedures:

The student will –

1. Measure and record temperatures of the pond at
   a) Various locations of the pond
   b) Various depths in the pond
   c) Various times of the day
   d) The same time of day for a week or more
2. Make a chart or graph showing the temperature at different depths of the pond.

Materials:

thermometer
maximum-minimum thermometer
string, marked in metric or English units

Note:

The student can obtain and record temperatures of the pond water at various locations, making comparisons between the temperature readings and animal and plant observations.

Air temperature can be compared with that just below the surface of the pond. The water temperature should be read while the thermometer is still in the water. Other than surface readings, the use of a regular thermometer is limited because as soon as it is raised or lowered into the pond, the thermometer reading will change also. For example, if the thermometer is lowered to the bottom and the temperature there is the coldest of the pond, as the thermometer is raised to the surface where the water is warmer, the reading will be higher and not indicative of the bottom temperature.

Temperature readings may also be taken at different depths by using a maximum-minimum thermometer. Readings can be made at definite levels by marking an attached line in metric or English units and submerging the thermometer to a given depth. Caution should be exercised in interpreting readings when the air temperature is colder than the water surface. It is possible for deeper water to be warmer than the surface, due to cold air blowing across the pond. If this condition exists, when the "max-min" thermometer is pulled up from deep water, it may show a lower "minimum" temperature than actually exists at the recording depth. A systematic recording, going down at one-half meter intervals and taking a reading at each level, may produce the true temperature profile. (The data collected may be difficult to decipher.)

The graph could be made indicating temperature readings at a given location of the pond each hour of the day. Or readings could be made at the same time each day for a week, etc. Comparisons with air temperatures may prove interesting when recorded throughout a year.

Activity 7: Observing Suspended Particles

Instructional Objective:

The student will demonstrate and describe material held in suspension in pond water.

Procedures:

The student will –

1. Collect a sample of water from the pond. Allow time for the material in the water to settle.

2. Collect a sample of water from the pond and add a small amount of alum. Allow time for the material in the water to settle.

3. Collect a sample of water from the pond and boil a small amount of water away. Allow time for the material in the water to settle.

4. Compare the amounts of sediment in each of the three vials.

Materials:

tall, slender plastic or glass containers such as pickle or olive jars with covers
powdered alum
hot plate or alcohol lamp
small pan or test tube

Note:

The student should collect equal samples of water from various locations of the pond and permit these specimens to settle. Compare the amount of sediment in each container.

One sample of water should be boiled only long enough to kill microscopic plant or animal life. (Approximately 1 minute should be enough, depending on volume of water and heat source.) Each specimen should be covered and left undisturbed. Compare and record the amount of sediment in each of the three containers. Take samples at various times and compare results. Sometimes the amount of sediment will be too little to be observed easily.

Activity 8: Measuring Turbidity

Instructional Objective:

The student will demonstrate the turbidity of the pond water by suspending a painted disc into the water and naming the depth at which the disc disappears.

Procedures:

The student will –

1. Take a painted disc tied to a string and submerge the disc until it disappears.

2. Measure the depth at which the disc disappears.

3. Slowly raise it until it appears again. An average of the two readings is the measure.

Materials:

string marked in metric or English units
disc divided in fourths with opposite sections painted black and the other sections painted white

Note:

This device is called a Secchi (sek'kee) disc after the person who introduced it in 1865. The string attached to the disc can be marked in metric or English units. An inexpensive disc can be improvised from a 20 cm. (8 inch) metal pot lid or cover, by painting it black and white, and attaching a line to its knob. If a disc is fashioned from wood, it must be weighted enough so it will hang straight in the water.

The student can compare the turbidity of the pond water at various locations in the pond. Comparisons can be made at intervals throughout the year, before and after a heavy rain, snow, or freeze, etc. Differences will occur throughout the year – especially in spring and fall – due to "blooms" of organisms. Predominant species in a "bloom" may change every two weeks, causing turbidity changes, too.

In Lake Tahoe, California, one of the clearest lakes in the world, a Secchi disc disappears at 33m (about 107 feet). Generally a disc's disappearance is equivalent with 5% to 15% solar radiation penetration.

Activity 9: Bottom Sampling

Instructional Objective:

The student will demonstrate how to take a core or dredge sample and will order what he observes present in the samples.

Procedures:

The student will –

1. Take a core sampling of the bottom of the pond to identify stratification or layers of sediments. (See "Note" for directions.)

2. Use a bottom dredge to obtain a sample from the pond bottom. (See "Note" for directions.)

Materials:

plastic or metal pipe, about 2 inches in diameter, 2 to 3 feet long
hand lens
trough to hold core material
bottom sampler

Note:

The student can use either a plastic or metal pipe and draw a core sampling from the bottom of the pond. Once he has plunged the tube into the bottom sediment, he must close the top of the tube with his hand so as to prevent the core from being lost in the water. He should record the location where he obtained his sampling. He may be able to see whether the sediments are in layers. He can group the types of organic and inorganic substances found in his samplings by making a list of the things he sees. A broomstick can be used to push out the core. A trough or cradle needs to be improvised to catch and hold the core sediment as it is pushed out.

A bottom sampler for deep areas can be improvised by tying a clothesline or wire to the handle of a discarded metal bucket. A few holes are punched into the bottom and sides of the bucket. The bucket is thrown into the pond, allowed to sink to the bottom, pulled along for a few yards and then quickly pulled to the surface. The bottom debris is poured into a flat pan or wide container for further investigation. A white porcelain pan is best because dark materials are easily seen against the white background.

Another type of bottom sampler, suitable for shallow areas, is constructed by nailing a metal can, about pint size, to the end of a broomstick. A few holes are punched into the bottom and sides of the can to allow excess water to pass out. The can is placed at an angle to facilitate scraping the can along the bottom.

Activity 10: Observing Currents

Instructional Objective:

The student will identify the motion of the water in the pond and trace its movement on a grid-sketch of the pond.

Procedures:

The student will –

1. Place a float on the pond. (See "Note" for directions.)

2. Chart the path of the float on a grid-sketch of the pond.

Materials:

corks or any objects which act as floats
weights such as washers, bolts, etc.

Note:

This activity will relate to the study of ocean currents. The student will see that even small bodies of water have currents. He may correlate his observations with the locations of observed animal life in the water. He should be able to predict by the flow of current where he will see more or less animal life. Chart the movement of the water in a pond or lake by placing corks (with weights tied on them) in the water. Each weight should dangle six inches or more below the cork. The purpose of the weight submerged in the water is to stabilize the cork so that it will move only due to the water current and not be easily blown across the pond by wind current.

Mark the corks in some way so each student can identify and chart his own cork. The tops of the corks can be marked with different designs or colors. (Later in the classroom, the students can make a compilation of their results, using graphs, tables, or grid-sketch of the pond.)

The student may also wish to time his float between two positions, such as from grid line 1 to grid line 2. The class may average how long it takes for all floats to cross the pond.

Variations may be made by altering the weights used, the length of string attached to the cork, and the size and composition of the floats used. A sail on the cork could be improvised with a toothpick or pin and a piece of stiff card or paper. The effect of this could be observed.

An alternative would be to use dye (such as Easter egg dye). Drop some dye on the water surface, and time its movement. Because dye diffuses rapidly, the accuracy of this technique is lessened. Its advantage is that it stains water below the surface, so movement is not limited to only surface current. This would be especially useful in a fast-moving stream where surface current may differ greatly from that below the surface.

Activity 11: Measuring the Inflow and Outflow of a Pond

Instructional Objective:

The student will apply a rule, by figuring the approximate amount of water flowing into the pond, or the amount leaving the pond, for a given period of time.

Procedures:

The student will –

1. Measure the amount of water flowing into the pond.

2. Measure the amount of water in a 10 foot length of a stream, flowing into the pond.

Note:

If a stream is flowing into a pond, the student can determine the rate of flow by placing a food coloring or dye on the water. The float such as a cork would measure only surface current; and in a stream, current may be much faster below the surface. He can measure the amount of time it takes the dye to move 10 feet. He then can measure the approximate depth and width of the stream to determine how much water is flowing into the pond per minute. It is assumed that a cross-section of the stream is approximately rectangular in the following example:

Depth of stream: 6 in.
Distance across: 20 in.
Rate of flow is 10 ft. in 10 minutes.

10' x 6" x 20" = 10" x 1/2' x 1-2/3' = 8-1/3 cu. ft. (for 10 min.)
1 cu. ft. = 7.5 gal. of water
8.3 x 7.5 = 62.25 gallons (for 10 min.)
or $\frac{62.25}{10}$ = 6.225 gal. per minute
or 60 x 6.225 = 373.5 gal. per hour

If the stream bed cross-section looks more like a triangle, then it would be about half the amount shown.

The output of water can be figured in the same way. The student may find a difference in the input and output volume of water. Can he explain why? (There is evaporation of the pond water as well as seepage into the pond bed.)

BASIC REFERENCES

Amox, William H. *Life of the Pond.* New York: McGraw-Hill Book Co., 1967. 232 pp.

A colorful and generously illustrated book on the ecology of North American ponds. Suitable for Grade 6 and above. One of the *Our Living World of Nature* series.

———. *Limnology.* Chestertown, Maryland: LaMotte Chemical Products Company, 1969. 40 pp. (pbk.)

A compact yet comprehensive treatment of the biological and physical characteristics of fresh water habitats. A teacher reference; slightly technical.

Farb, Peter. *Ecology.* New York: Time, Inc., 1963. 192 pp.

Color photographs by LIFE. One of the *Life Nature Library* series. Wide coverage of ecology of a variety of habitats. Up-to-date concepts and phenomena. A unique publication. Suitable for junior high and above.

Reid, George K. *Pond Life.* New York: Golden Press, 1967. 160 pp. (pbk.)

A colorful pocket size *Golden Nature Guide,* available at many local stores. Useful as a field guide for identifying organisms as well as a general reference on pond ecology. A best buy, suitable for Grade 6 and above.

STUDENT EVALUATION SHEET

Student's Name_____

	Observed	Not Observed
1. Identifies animal life	_____	_____
2. Identifies plant life	_____	_____
3. Uses a plankton tow	_____	_____
4. Measures pH	_____	_____
5. Measures pond depth	_____	_____
6. Measures pond temperatures	_____	_____
7. Observes suspended particles	_____	_____
8. Measures turbidity	_____	_____
9. Takes core or dredge sample of pond bottom	_____	_____
10. Observes currents	_____	_____
11. Measures inflow and outflow	_____	_____